DOCUMENT-IDENTIFIER: NN9207373

TITLE: Magneto Optic Sensor for Vortices in a
Superconductor.

---------- KWIC ---------

- Disclosed is a device for detecting a vortex or a bundle
of vortices used as
a storage bit in a superconducting vortex memory. A vortex
storage system in
which mobile vortices, the information bits, are moved in
a shift register by
currents and are read out by passing them under a
Josephson junction which
serves as a detector is proposed in (*). In this system,
the presence or
absence of a vortex or a vortex bundle represents binary
"1" and "0." With the
advent of the high Tc superconductors, the vortex storage
system has become
more practical both because it can be operated at liquid
nitrogen temperature
and because some of these compounds have very mobile
vortices. This is
evidenced by the observation that some high quality films
and single crystals
have low critical currents at 77~K. This is particularly
true of some of the
Bi and Tl copper oxide superconductor compositions in
thin-film form. Also,
because the vortex mobility (1/viscosity) increases as the
normal state
resistivity decreases, the oxide superconductors are
particularity well suited
since they tend to have few carriers and, therefore, a
high resistivity in the
normal state. The mobility is inversely proportional to
the upper critical
field which means that these devices will work best close
to Tc where the
critical field is low. - One of the difficulties of using
these

superconductors is that reliable Josephson detectors have not been
successfully fabricated. Disclosed is a device for the magneto-optic detection
of a vortex bundle eliminating the need for a Josephson junction detector.
The detector, shown in Fig. 1, consists of a thin film of a magneto-optic
transducer 1 deposited on a reflector layer 2 which is, in turn, deposited on
the superconductor 3. A suitable magneto-optic transducer is a 2500 A thick
film of EuS deposited by electron beam evaporation from an EuS source. A film
of this thickness has a Faraday rotation of 20 degrees at a wavelength of 6328
A in an applied field of 31 kF at a temperature of 20~K. The reflector is a
thin layer of silver deposited on a film of YBa2Cu3O7 which has been prepared
by laser ablation in a separate evaporator. Other parts of the detector
consist of a coil 4 for applying a magnetic field locally to the detector, a
source of polarized light 5, a means 6 of detecting the polarization state of
the light reflected from the surface and a magnetic field source (not shown)
to apply a bias field near the lower critical field Hc1. The optical system
used in a magneto-optical recording head is suitable for this detector. In
operation, the shift register is stepped by one to move a vortex bundle, if
present, into the detector region. A current pulse is sent through the coil
and, at the same time, the detector region is illuminated with polarized
light. If there are no vortices present the superconductor will shield the MO
transducer from the field and there will be no change in the rotation of the
plane of polarization and the detector will register a
"0." If a vortex bundle
is present, the magnetic flux will be carried through the cores of the
vortices resulting in a local field opposite to that of

the shielding field,
causing a change in the rotation of the plane of
polarization. This will
register as a "1." The signal will be proportional to the
relative area of
vortex cores to the total area illuminated. The field
above the core is
determined by both the penetration depth and coherence
length, and is about
two times as large as Hc1 at the center of the flux
vortex. The area
associated with the core is proportional to the square of
the coherence length
(25x10-8cm). The core is in the normal
(nonsuperconducting state) over this
area so that the signal will simply depend on the
fractional area. The ratio
of core area to total area goes approximately like H/Hc2
where H is the
applied field and Hc2 is the upper critical field. For a
fixed bias field the
core area will increase with temperature. By using an
injection laser as a
light source it should be possible to warm the
superconductor to a temperature
closer to Tc during readout so as to make the MO signal
larger. Also, the
thickness of the EuS can be adjusted to 1/4 of the
wavelength to enhance the
MO signal by multiple reflections. - The rotation of EuS
on a silver
reflector deposited on a thin film of 123 superconductor
is shown in Fig. 2.
The temperature dependence is shown for a sample immersed
in a uniform
external field and illuminated with 6328 A laser light.
Shielding currents at
the periphery of the film set up a field at the surface of
the sample equal
and opposite to the applied field. At the superconducting
Tc of the sample
(about 75~K in this case) flux penetrates the film and the
EuS magneto-optic
transducer registers a positive field. The other curve in
the figure is the
normal temperature dependence of the EuS. Other materials
with large

magneto-optic rotation would be suitable as a transducer
in this application.
- Reference (*) W. Baechtold, "The Vortex File: A New
Application of Type-II
Superconductivity," IBM Research Report RZ 842, Zurich,
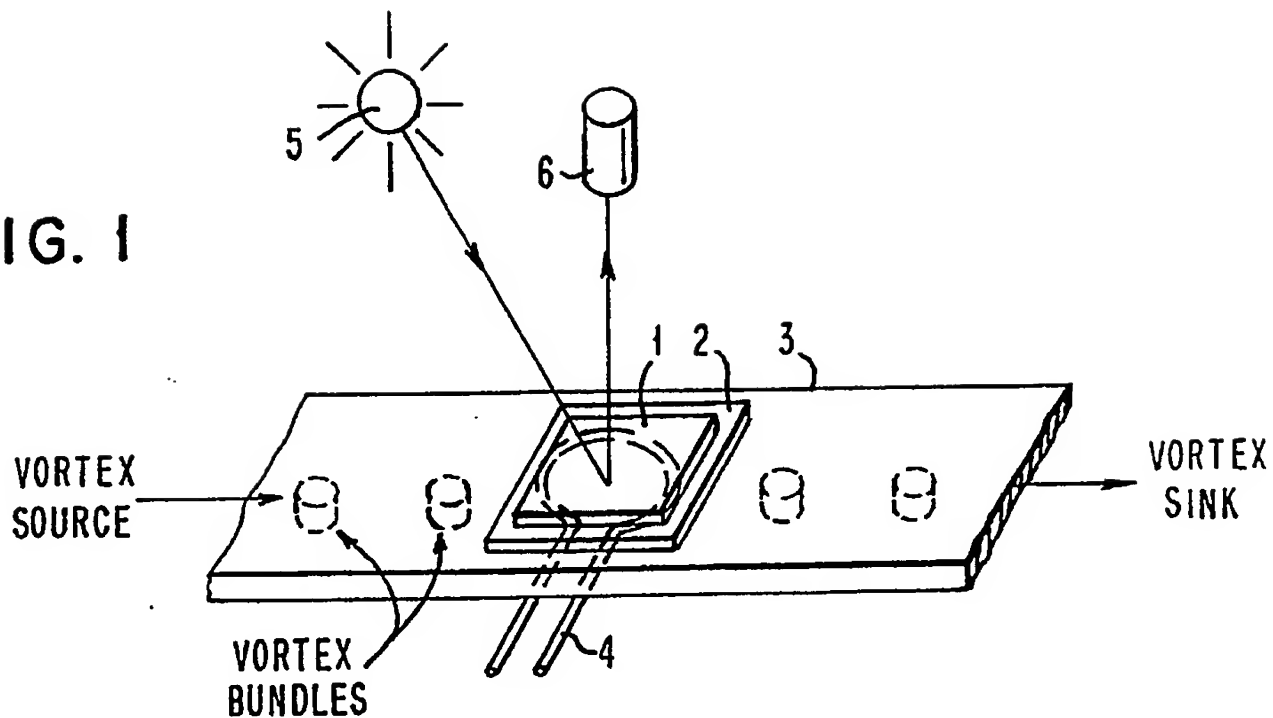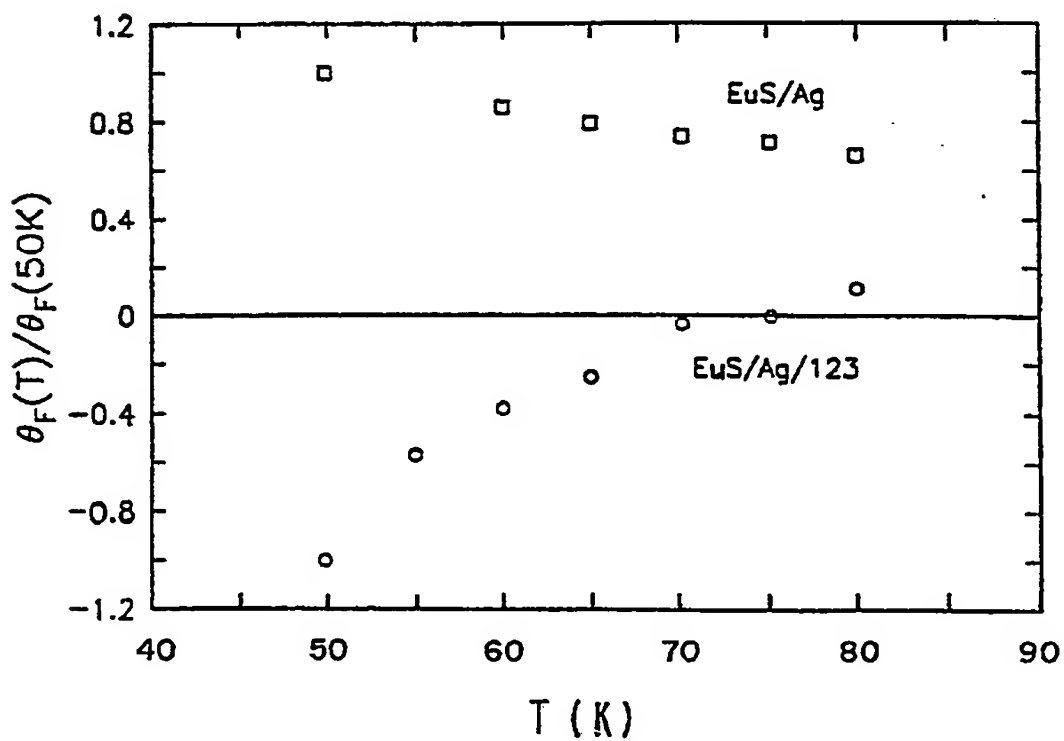Switzer land (June
1977).

FIG. 1

5

6

1 2 3

VORTEX
SOURCE

4

VORTEX
BUNDLES

VORTEX
SINK

FIG. 2

$\theta_F(T)/\theta_F(50K)$

1.2

0.8

0.4

0

-0.4

-0.8

-1.2

EuS/Ag

EuS/Ag/123

40   50   60   70   80   90

T (K)

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29	15	((((vortex or vortices).ab.) and (vortex or vortices).clm.) and (method or process).clm.) and (pin or pinning or pinned).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/26 09:41

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36	2	(((pin or pinning or pinned).ti,ab,clm. and (vortex or vortices).ti,ab,clm. and (superconducting or superconductor).ti,ab,clm.) and flux) and (sputter or sputtering or sputtered)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/26 09:54
37	1	(((pin or pinning or pinned).ti,ab,clm. and (vortex or vortices).ti,ab,clm. and (superconducting or superconductor).ti,ab,clm.) and flux) and (store or storing or stored).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/26 09:55
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-	24989	(vortex or vortices).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 11:42
-	277	((vortex or vortices).ti,ab,clm.) and (pin or pinning or pinned).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 11:42
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-		34	(((vortex or vortices).ti,ab,clm.) and (pin or pinning or pinned).ti,ab,clm.) and ((pin or pinning or pinned) near5 (vortex or vortices)).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 11:46
-		1	((vortex or vortices) same (pin or pinning or pinned) same flux).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 11:47
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-		71	((vortex or vortices) and (pin or pinning or pinned) and flux and (memory or storage or storing or stored or ram) and ((magnetic or magnetically) near2 field))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 11:51
-		20	((vortex or vortices) and (pin or pinning or pinned) and flux and (memory or storage or storing or stored or ram) and ((magnetic or magnetically) near2 field) and (rf or (radio near frequency) or magnetron or sputter or sputtering or sputtered) and (dope or doping or doped or dopant or impurity))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 11:53
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-		1	((vortices or vortex) and (dipole or dipolar) and (store or storing or storage or memory or ram)).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:07

-	1	4186441.URPN.	USPAT	2003/01/22 12:00
-	2	("3936809" | "4082991").PN.	USPAT	2003/01/22 12:00
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-	5	((vortices or vortex) same (pin or pinning or pinned) same (store or storing or storage or memory or ram)).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:18
-	5	6269018.URPN.	USPAT	2003/01/22 12:08
-	11	("5541868" | "5640343" | "5695864" | "5734605" | "5764567" | "5793697" | "5801984" | "5841692" | "6072718" | "6114719" | "6130835").PN.	USPAT	2003/01/22 12:10
-	24989	(vortex or vortices).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:18
-	277	((vortex or vortices).ti,ab,clm.) and (pin or pinning or pinned).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:19
-	17	(((vortex or vortices).ti,ab,clm.) and (pin or pinning or pinned).ti,ab,clm.) and (store or storing or stored or storage or memory or ram).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:20
-	1184	((superconducting or superconductor) near5 (memory or storage or store or storing or stored or memory or ram)).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:21
-	737	(((superconducting or superconductor) near5 (memory or storage or store or storing or stored or memory or ram)).ti,ab,clm.) and ((superconducting or superconductor) near5 (memory or storage or store or storing or stored or memory or ram)).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:21

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		4	4764898.URPN.	USPAT	2003/01/22 12:23
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·	4	((((((superconducting or superconductor) near5 (memory or storage or store or storing or stored or memory or ram)).ti,ab,clm.) and ((superconducting or superconductor) near5 (memory or storage or store or storing or stored or memory or ram)).ab.) and ((superconducting or superconductor) near5 (memory or storage or store or storing or stored or memory or ram)).clm.) and (vortex or vortices)) and (flux).ti,ab,clm.	USPAT; US-PGPUB; EPO; JP ; DERWENT; IBM_TDB	2003/01/22 12:23
·	6	5289150.URPN.	USPAT	2003/01/22 12:24
·	5	("4000036" | "4176291" | "4348630" | "5011823" | "5110793").PN.	USPAT	2003/01/22 12:24
·	9	5388068.URPN.	USPAT	2003/01/22 12:24
·	50	("3387286" | "3744038" | "3914702" | "3953749" | "4130893" | "4360898" | "4398267" | "4414480" | "4430582" | "4437227" | "4458495" | "4499119" | "4509146" | "4518868" | "4609836" | "4633439" | "4638185" | "4638187" | "4663620" | "4706240" | "4710649" | "4719369" | "4727266" | "4760292" | "4779230" | "4780750" | "4785426" | "4791321" | "4807183" | "4817082" | "4837536" | "4845539" | "4845722" | "4849751" | "4852083" | "4859897" | "4888629" | "4891682" | "4920512" | "4974205" | "4980580" | "4994434" | "5024993" | "5030617" | "5051627" | "5057491" | "5071832" | "5107461" | "5166562" | "5253199").PN.	USPAT	2003/01/22 12:25
·	50	("3387286" | "3744038" | "3914702" | "3953749" | "4130893" | "4360898" | "4398267" | "4414480" | "4430582" | "4437227" | "4458495" | "4499119" | "4509146" | "4518868" | "4609836" | "4633439" | "4638185" | "4638187" | "4663620" | "4706240" | "4710649" | "4719369" | "4727266" | "4760292" | "4779230" | "4780750" | "4785426" | "4791321" | "4807183" | "4817082" | "4837536" | "4845539" | "4845722" | "4849751" | "4852083" | "4859897" | "4888629" | "4891682" | "4920512" | "4974205" | "4980580" | "4994434" | "5024993" | "5030617" | "5051627" | "5057491" | "5071832" | "5107461" | "5166562" | "5253199").PN.	USPAT	2003/01/22 12:25

| | 259 | (US-5079219-$ or US-4186441-$ or US-3999204-$ or US-3775673-$ or US-3676718-$ or US-6023161-$ or US-5683967-$ or US-5338943-$ or US-6269018-$ or US-6266289-$ or US-5827170-$ or US-4869598-$ or US-4409579-$ or US-6452764-$ or US-6368878-$ or US-6221812-$ or US-6188920-$ or US-6104633-$ or US-5946228-$ or US-5912210-$ or US-5798318-$ or US-5627140-$ or US-5479059-$ or US-5378999-$ or US-5053707-$ or US-4997809-$).did. or (US-4921834-$ or US-4861751-$ or US-6475223-$ or US-6445184-$ or US-6304768-$ or US-6298259-$ or US-6272370-$ or US-6237399-$ or US-6212419-$ or US-6211673-$ or US-6157853-$ or US-6081402-$ or US-6015414-$ or US-6014580-$ or US-5909119-$ or US-5619139-$ or US-5214981-$ or US-5075280-$ or US-6479176-$ or US-6312893-$ or US-6303242-$ or US-6207313-$ or US-6187032-$ or US-6083885-$ or US-6054855-$ or US-6001248-$ or US-5986453-$).did. or (US-5981095-$ or US-5928804-$ or US-5871625-$ or US-5817221-$ or US-5706404-$ or US-5666467-$ or US-5491411-$ or US-5325002-$ or US-5289150-$ or US-5093313-$ or US-5070702-$ or US-4939976-$ or US-4802951-$ or US-4728591-$ or US-4190817-$ or US-6317303-$ or US-6242939-$ or US-6193194-$ or US-6078517-$ or US-5953224-$ or US-5942765-$ or US-5903152-$ or US-5872731-$ or US-5726873-$ or US-5656870-$ or US-5644218-$ or US-5629889-$).did. or (US-5625548-$ or US-5610958-$ or US-5532664-$ or US-5532638-$ or US-5523914-$ or US-5521570-$ or US-5519312-$ or US-5514915-$ or US-5388068-$ or US-5377141-$ or US-5376828-$ or US-5374914-$ or US-5359308-$ or US-5345154-$ or US-5339062-$ or US-5323344-$ or US-5315277-$ or US-5303111-$ or US-5260264-$ or US-5247475-$ or US-5194803-$ or US-5181170-$ or US-5160911-$ or US-5159261-$ or US-5146383-$ or US-5132618-$ or US-5130687-$).did. or (US-5115219-$ or US-5054787-$ or US-5041880-$ or US-5001398-$ or US-4982571-$ or US-4962354-$ or US-4940983-$ or | USPAT; US-PGPUB; EP ; JPO; DERWENT; IBM_TDB | 2003/01/22 12:41 |

| | | 10 | (((US-5079219-$ or US-4186441-$ or US-3999204-$ or US-3775673-$ or US-3676718-$ or US-6023161-$ or US-5683967-$ or US-5338943-$ or US-6269018-$ or US-6266289-$ or US-5827170-$ or US-4869598-$ or US-4409579-$ or US-6452764-$ or US-6368878-$ or US-6221812-$ or US-6188920-$ or US-6104633-$ or US-5946228-$ or US-5912210-$ or US-5798318-$ or US-5627140-$ or US-5479059-$ or US-5378999-$ or US-5053707-$ or US-4997809-$).did. or (US-4921834-$ or US-4861751-$ or US-6475223-$ or US-6445184-$ or US-6304768-$ or US-6298259-$ or US-6272370-$ or US-6237399-$ or US-6212419-$ or US-6211673-$ or US-6157853-$ or US-6081402-$ or US-6015414-$ or US-6014580-$ or US-5909119-$ or US-5619139-$ or US-5214981-$ or US-5075280-$ or US-6479176-$ or US-6312893-$ or US-6303242-$ or US-6207313-$ or US-6187032-$ or US-6083885-$ or US-6054855-$ or US-6001248-$ or US-5986453-$).did. or (US-5981095-$ or US-5928804-$ or US-5871625-$ or US-5817221-$ or US-5706404-$ or US-5666467-$ or US-5491411-$ or US-5325002-$ or US-5289150-$ or US-5093313-$ or US-5070702-$ or US-4939976-$ or US-4802951-$ or US-4728591-$ or US-4190817-$ or US-6317303-$ or US-6242939-$ or US-6193194-$ or US-6078517-$ or US-5953224-$ or US-5942765-$ or US-5903152-$ or US-5872731-$ or US-5726873-$ or US-5656870-$ or US-5644218-$ or US-5629889-$).did. or (US-5625548-$ or US-5610958-$ or US-5532664-$ or US-5532638-$ or US-5523914-$ or US-5521570-$ or US-5519312-$ or US-5514915-$ or US-5388068-$ or US-5377141-$ or US-5376828-$ or US-5374914-$ or US-5359308-$ or US-5345154-$ or US-5339062-$ or US-5323344-$ or US-5315277-$ or US-5303111-$ or US-5260264-$ or US-5247475-$ or US-5194803-$ or US-5181170-$ or US-5160911-$ or US-5159261-$ or US-5146383-$ or US-5132618-$ or US-5130687-$).did. or (US-5115219-$ or US-5052737-$ or US-5041880-$ or US-5030938-$ or US-4982571-$ or US-4962354-$ or US-4940983-$ or | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB | 2003/01/22 12:44 |

| | | 27 | ((US-5079219-$ or US-4186441-$ or US-3999204-$ or US-3775673-$ or US-3676718-$ or US-6023161-$ or US-5683967-$ or US-5338943-$ or US-6269018-$ or US-6266289-$ or US-5827170-$ or US-4869598-$ or US-4409579-$ or US-6452764-$ or US-6368878-$ or US-6221812-$ or US-6188920-$ or US-6104633-$ or US-5946228-$ or US-5912210-$ or US-5798318-$ or US-5627140-$ or US-5479059-$ or US-5378999-$ or US-5053707-$ or US-4997809-$).did. or (US-4921834-$ or US-4861751-$ or US-6475223-$ or US-6445184-$ or US-6304768-$ or US-6298259-$ or US-6272370-$ or US-6237399-$ or US-6212419-$ or US-6211673-$ or US-6157853-$ or US-6081402-$ or US-6015414-$ or US-6014580-$ or US-5909119-$ or US-5619139-$ or US-5214981-$ or US-5075280-$ or US-6479176-$ or US-6312893-$ or US-6303242-$ or US-6207313-$ or US-6187032-$ or US-6083885-$ or US-6054855-$ or US-6001248-$ or US-5986453-$).did. or (US-5981095-$ or US-5928804-$ or US-5871625-$ or US-5817221-$ or US-5706404-$ or US-5666467-$ or US-5491411-$ or US-5325002-$ or US-5289150-$ or US-5093313-$ or US-5070702-$ or US-4939976-$ or US-4802951-$ or US-4728591-$ or US-4190817-$ or US-6317303-$ or US-6242939-$ or US-6193194-$ or US-6078517-$ or US-5953224-$ or US-5942765-$ or US-5903152-$ or US-5872731-$ or US-5726873-$ or US-5656870-$ or US-5644218-$ or US-5629889-$).did. or (US-5625548-$ or US-5610958-$ or US-5532664-$ or US-5532638-$ or US-5523914-$ or US-5521570-$ or US-5519312-$ or US-5514915-$ or US-5388068-$ or US-5377141-$ or US-5376828-$ or US-5374914-$ or US-5359308-$ or US-5345154-$ or US-5339062-$ or US-5323344-$ or US-5315277-$ or US-5303111-$ or US-5260264-$ or US-5247475-$ or US-5194803-$ or US-5181170-$ or US-5160911-$ or US-5159261-$ or US-5146383-$ or US-5132618-$ or US-5130687-$).did. or (US-5115219-$ or US-5054727-$ or US-5041880-$ or US-5003198-$ or US-4982571-$ or US-4962354-$ or US-4940983-$ or | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB | 2003/01/22 12:45 |

•	85	(vortex or vortices).clm. and (pin or pinning or pinned).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:47
•	3	((vortex or vortices).clm. and (pin or pinning or pinned).clm.) and (superconducting or superconductor)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:48
•	277	(vortex or vortices).ti,ab,clm. and (pin or pinning or pinned).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:48
•	18	((vortex or vortices).ti,ab,clm. and (pin or pinning or pinned).ti,ab,clm.) and (superconducting or superconductor)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:49
•	17	((vortex or vortices).ti,ab,clm. and (pin or pinning or pinned).ti,ab,clm.) and (superconducting or superconductor).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:49
•	12	((vortex or vortices).ti,ab,clm. and (pin or pinning or pinned).ti,ab,clm.) and (store or storing or stored or memory or ram).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 12:50
•	3	(((vortex or vortices).ti,ab,clm. and (pin or pinning or pinned).ti,ab,clm.) and (superconducting or superconductor).ti,ab,clm.) and (store or storing or stored or memory or ram).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:25
•	737	((superconducting or superconductor) near5 (store or storing or stored or storage or memory or ram)).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:26
•	65	(((superconducting or superconductor) near5 (store or storing or stored or storage or memory or ram)).ab.) and ((superconducting or superconductor) near5 (store or storing or stored or storage or memory or ram)).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:27
•	11	(((superconducting or superconductor) near5 (store or storing or stored or storage or memory or ram)).ab.) and (pin or pinning or pinned) and flux	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:30

•	9	((((superconducting or superconductor) near5 (store or storing or stored or storage or memory or ram)).ab.) and (pin or pinning or pinned) and flux) and (magnetic near field)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:31
•	3	(((((superconducting or superconductor) near5 (store or storing or stored or storage or memory or ram)).ab.) and (pin or pinning or pinned) and flux) and (magnetic near field)) and (vertex or vortices or vortex or vortical or vortexes)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:32
•	4	4764898.URPN.	USPAT	2003/01/22 13:32
•	33658	(vortex or vertex or vortexes or vortices or vortical).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:33
•	4476	((vortex or vertex or vortexes or vortices or vortical).ab.) and (vortex or vertex or vortexes or vortices or vortical).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:34
•	150	(((vortex or vertex or vortexes or vortices or vortical).ab.) and (vortex or vertex or vortexes or vortices or vortical).clm.) and (magnetic or magnetically or magnetical).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:35
•	19	((((vortex or vertex or vortexes or vortices or vortical).ab.) and (vortex or vertex or vortexes or vortices or vortical).clm.) and (magnetic or magnetically or magnetical).clm.) and (store or storing or stored or storage or memory or ram).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:35
•	13	(((((vortex or vertex or vortexes or vortices or vortical).ab.) and (vortex or vertex or vortexes or vortices or vortical).clm.) and (magnetic or magnetically or magnetical).clm.) and (store or storing or stored or storage or memory or ram).clm.) and (store or storing or stored or storage or memory or ram).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:36
•	3	((((((vortex or vertex or vortexes or vortices or vortical).ab.) and (vortex or vertex or vortexes or vortices or vortical).clm.) and (magnetic or magnetically or magnetical).clm.) and (store or storing or stored or storage or memory or ram).clm.) and (store or storing or stored or storage or memory or ram).ab.) and (pin or pinning or pinned)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:37
•	1	4186441.URPN.	USPAT	2003/01/22 13:37

-		2	5079219.URPN.		USPAT	2003/01/22 13:38

| - | 273 | (US-5079219-$ or US-4186441-$ or US-3999204-$ or US-3775673-$ or US-3676718-$ or US-6023161-$ or US-5683967-$ or US-5338943-$ or US-6269018-$ or US-6266289-$ or US-5827170-$ or US-4869598-$ or US-4409579-$ or US-6452764-$ or US-6368878-$ or US-6221812-$ or US-6188920-$ or US-6104633-$ or US-5946228-$ or US-5912210-$ or US-5798318-$ or US-5627140-$ or US-5479059-$ or US-5378999-$ or US-5053707-$ or US-4997809-$).did. or (US-4921834-$ or US-4861751-$ or US-6475223-$ or US-6445184-$ or US-6304768-$ or US-6298259-$ or US-6272370-$ or US-6237399-$ or US-6212419-$ or US-6211673-$ or US-6157853-$ or US-6081402-$ or US-6015414-$ or US-6014580-$ or US-5909119-$ or US-5619139-$ or US-5214981-$ or US-5075280-$ or US-6479176-$ or US-6312893-$ or US-6303242-$ or US-6207313-$ or US-6187032-$ or US-6083885-$ or US-6054855-$ or US-6001248-$ or US-5986453-$).did. or (US-5981095-$ or US-5928804-$ or US-5871625-$ or US-5817221-$ or US-5706404-$ or US-5666467-$ or US-5491411-$ or US-5325002-$ or US-5289150-$ or US-5093313-$ or US-5070702-$ or US-4939976-$ or US-4802951-$ or US-4728591-$ or US-4190817-$ or US-6317303-$ or US-6242939-$ or US-6193194-$ or US-6078517-$ or US-5953224-$ or US-5942765-$ or US-5903152-$ or US-5872731-$ or US-5726873-$ or US-5656870-$ or US-5644218-$ or US-5629889-$).did. or (US-5625548-$ or US-5610958-$ or US-5532664-$ or US-5532638-$ or US-5523914-$ or US-5521570-$ or US-5519312-$ or US-5514915-$ or US-5388068-$ or US-5377141-$ or US-5376828-$ or US-5374914-$ or US-5359308-$ or US-5345154-$ or US-5339062-$ or US-5323344-$ or US-5315277-$ or US-5303111-$ or US-5260264-$ or US-5247475-$ or US-5194803-$ or US-5181170-$ or US-5160911-$ or US-5159261-$ or US-5146383-$ or US-5132618-$ or US-5130687-$).did. or (US-5115219-$ or US-5052707-$ or US-5041880-$ or US-5003505-$ or US-4982571-$ or US-4962354-$ or US-4940983-$ or | USPAT; US-P PUB; EPO; JPO; DERWENT; IBM_TDB | 2003/01/22 13:39 |

| | | 137 | ((US-5079219-$ or US-4186441-$ or US-3999204-$ or US-3775673-$ or US-3676718-$ or US-6023161-$ or US-5683967-$ or US-5338943-$ or US-6269018-$ or US-6266289-$ or US-5827170-$ or US-4869598-$ or US-4409579-$ or US-6452764-$ or US-6368878-$ or US-6221812-$ or US-6188920-$ or US-6104633-$ or US-5946228-$ or US-5912210-$ or US-5798318-$ or US-5627140-$ or US-5479059-$ or US-5378999-$ or US-5053707-$ or US-4997809-$).did. or (US-4921834-$ or US-4861751-$ or US-6475223-$ or US-6445184-$ or US-6304768-$ or US-6298259-$ or US-6272370-$ or US-6237399-$ or US-6212419-$ or US-6211673-$ or US-6157853-$ or US-6081402-$ or US-6015414-$ or US-6014580-$ or US-5909119-$ or US-5619139-$ or US-5214981-$ or US-5075280-$ or US-6479176-$ or US-6312893-$ or US-6303242-$ or US-6207313-$ or US-6187032-$ or US-6083885-$ or US-6054855-$ or US-6001248-$ or US-5986453-$).did. or (US-5981095-$ or US-5928804-$ or US-5871625-$ or US-5817221-$ or US-5706404-$ or US-5666467-$ or US-5491411-$ or US-5325002-$ or US-5289150-$ or US-5093313-$ or US-5070702-$ or US-4939976-$ or US-4802951-$ or US-4728591-$ or US-4190817-$ or US-6317303-$ or US-6242939-$ or US-6193194-$ or US-6078517-$ or US-5953224-$ or US-5942765-$ or US-5903152-$ or US-5872731-$ or US-5726873-$ or US-5656870-$ or US-5644218-$ or US-5629889-$).did. or (US-5625548-$ or US-5610958-$ or US-5532664-$ or US-5532638-$ or US-5523914-$ or US-5521570-$ or US-5519312-$ or US-5514915-$ or US-5388068-$ or US-5377141-$ or US-5376828-$ or US-5374914-$ or US-5359308-$ or US-5345154-$ or US-5339062-$ or US-5323344-$ or US-5315277-$ or US-5303111-$ or US-5260264-$ or US-5247475-$ or US-5194803-$ or US-5181170-$ or US-5160911-$ or US-5159261-$ or US-5146383-$ or US-5132618-$ or US-5130687-$).did. or (US-5115219-$ or US-5052797-$ or US-5041880-$ or US-5005986-$ or US-4982571-$ or US-4962354-$ or US-4940983-$ or | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB | 2003/01/22 13:39 |

| | | 14 | (((US-5079219-$ or US-4186441-$ or US-3999204-$ or US-3775673-$ or US-3676718-$ or US-6023161-$ or US-5683967-$ or US-5338943-$ or US-6269018-$ or US-6266289-$ or US-5827170-$ or US-4869598-$ or US-4409579-$ or US-6452764-$ or US-6368878-$ or US-6221812-$ or US-6188920-$ or US-6104633-$ or US-5946228-$ or US-5912210-$ or US-5798318-$ or US-5627140-$ or US-5479059-$ or US-5378999-$ or US-5053707-$ or US-4997809-$).did. or (US-4921834-$ or US-4861751-$ or US-6475223-$ or US-6445184-$ or US-6304768-$ or US-6298259-$ or US-6272370-$ or US-6237399-$ or US-6212419-$ or US-6211673-$ or US-6157853-$ or US-6081402-$ or US-6015414-$ or US-6014580-$ or US-5909119-$ or US-5619139-$ or US-5214981-$ or US-5075280-$ or US-6479176-$ or US-6312893-$ or US-6303242-$ or US-6207313-$ or US-6187032-$ or US-6083885-$ or US-6054855-$ or US-6001248-$ or US-5986453-$).did. or (US-5981095-$ or US-5928804-$ or US-5871625-$ or US-5817221-$ or US-5706404-$ or US-5666467-$ or US-5491411-$ or US-5325002-$ or US-5289150-$ or US-5093313-$ or US-5070702-$ or US-4939976-$ or US-4802951-$ or US-4728591-$ or US-4190817-$ or US-6317303-$ or US-6242939-$ or US-6193194-$ or US-6078517-$ or US-5953224-$ or US-5942765-$ or US-5903152-$ or US-5872731-$ or US-5726873-$ or US-5656870-$ or US-5644218-$ or US-5629889-$).did. or (US-5625548-$ or US-5610958-$ or US-5532664-$ or US-5532638-$ or US-5523914-$ or US-5521570-$ or US-5519312-$ or US-5514915-$ or US-5388068-$ or US-5377141-$ or US-5376828-$ or US-5374914-$ or US-5359308-$ or US-5345154-$ or US-5339062-$ or US-5323344-$ or US-5315277-$ or US-5303111-$ or US-5260264-$ or US-5247475-$ or US-5194803-$ or US-5181170-$ or US-5160911-$ or US-5159261-$ or US-5146383-$ or US-5132618-$ or US-5130687-$).did. or (US-5115219-$ or US-5052797-$ or US-5041880-$ or US-5005985-$ or US-4982571-$ or US-4962354-$ or US-4940983-$ or | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB | 2003/01/22 13:40 |

| | | 3 | (((((US-5079219-$ or US-4186441-$ or US-3999204-$ or US-3775673-$ or US-3676718-$ or US-6023161-$ or US-5683967-$ or US-5338943-$ or US-6269018-$ or US-6266289-$ or US-5827170-$ or US-4869598-$ or US-4409579-$ or US-6452764-$ or US-6368878-$ or US-6221812-$ or US-6188920-$ or US-6104633-$ or US-5946228-$ or US-5912210-$ or US-5798318-$ or US-5627140-$ or US-5479059-$ or US-5378999-$ or US-5053707-$ or US-4997809-$).did. or (US-4921834-$ or US-4861751-$ or US-6475223-$ or US-6445184-$ or US-6304768-$ or US-6298259-$ or US-6272370-$ or US-6237399-$ or US-6212419-$ or US-6211673-$ or US-6157853-$ or US-6081402-$ or US-6015414-$ or US-6014580-$ or US-5909119-$ or US-5619139-$ or US-5214981-$ or US-5075280-$ or US-6479176-$ or US-6312893-$ or US-6303242-$ or US-6207313-$ or US-6187032-$ or US-6083885-$ or US-6054855-$ or US-6001248-$ or US-5986453-$).did. or (US-5981095-$ or US-5928804-$ or US-5871625-$ or US-5817221-$ or US-5706404-$ or US-5666467-$ or US-5491411-$ or US-5325002-$ or US-5289150-$ or US-5093313-$ or US-5070702-$ or US-4939976-$ or US-4802951-$ or US-4728591-$ or US-4190817-$ or US-6317303-$ or US-6242939-$ or US-6193194-$ or US-6078517-$ or US-5953224-$ or US-5942765-$ or US-5903152-$ or US-5872731-$ or US-5726873-$ or US-5656870-$ or US-5644218-$ or US-5629889-$).did. or (US-5625548-$ or US-5610958-$ or US-5532664-$ or US-5532638-$ or US-5523914-$ or US-5521570-$ or US-5519312-$ or US-5514915-$ or US-5388068-$ or US-5377141-$ or US-5376828-$ or US-5374914-$ or US-5359308-$ or US-5345154-$ or US-5339062-$ or US-5323344-$ or US-5315277-$ or US-5303111-$ or US-5260264-$ or US-5247475-$ or US-5194803-$ or US-5181170-$ or US-5160911-$ or US-5159261-$ or US-5146383-$ or US-5132618-$ or US-5130687-$).did. or (US-5115219-$ or US-5052279-$ or US-3941880-$ or US-5005856-$ or US-4982571-$ or US-4962354-$ or US-4940983-$ or | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB | 2003/01/22 13:42 |

•		8	((pin or pinning or pinned) same (magnetic or magnetically or magnetical) same (vortex or vortices or vortexes or vertex) same (detect or detecting or detected or detector))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:47
•		5	(((pin or pinning or pinned) same (magnetic or magnetically or magnetical) same (vortex or vortices or vortexes or vertex) same (detect or detecting or detected or detector))) and flux	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:45
•		3	((pin or pinning or pinned) and (magnetic or magnetically or magnetical) and (vortex or vortices or vortexes or vertex) and (detect or detecting or detected or detector) and (dope or doped or doping) and (dipole or dipolar))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:48
•		24	((pin or pinning or pinned) and (magnetic or magnetically or magnetical) and (vortex or vortices or vortexes or vertex) and (detect or detecting or detected or detector) and (dipole or dipolar))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:50
•		20	((pin or pinning or pinned) and (magnetic or magnetically or magnetical) and (vortex or vortices or vortexes or vertex) and (detect or detecting or detected or detector) and (dipole or dipolar) and (store or storing or stored or storage or memory))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:51
•		8	((pin or pinning or pinned) and (magnetic or magnetically or magnetical) and (vortex or vortices or vortexes or vertex) and (detect or detecting or detected or detector) and (dipole or dipolar) and (store or storing or stored or storage or memory) and (superconducting or superconductor))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:53
•		7	((pin or pinning or pinned) and (magnetic or magnetically or magnetical) and (vortex or vortices or vortexes or vertex) and (detect or detecting or detected or detector) and (dipole or dipolar) and (store or storing or stored or storage or memory) and (superconducting or superconductor) and (tip or probe))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:54
•		0	(((pin or pinning or pinned) and (magnetic or magnetically or magnetical) and (vortex or vortices or vortexes or vertex) and (detect or detecting or detected or detector) and (dipole or dipolar) and (store or storing or stored or storage or memory) and (superconducting or superconductor) and (tip or probe))) and (vortex or vertex or vortices or vortexes).ti,ab,clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:54

		339	(pin or pinning or pinned) near3 (vertex or vortex or vortices or vortexes)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:55
-		50	((pin or pinning or pinned) near3 (vertex or vortex or vortices or vortexes)).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:56
-		1	(((pin or pinning or pinned) near3 (vertex or vortex or vortices or vortexes)).clm.) and flux.clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:57
-		3	(((pin or pinning or pinned) near3 (vertex or vortex or vortices or vortexes)).clm.) and (store or storing or stored or storage).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 13:59
-		41	(magnetic near (vortex or vortices)).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:00
-		47	((magnetic near (vortex or vortices)).ab.) (magnetic near (vortex or vortices)).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:00
-		4	((magnetic near (vortex or vortices)).ab.) and (magnetic near (vortex or vortices)).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:01
-		9	(superconducting same (vortex or vortices)).ti.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:02
-		0	((((superconducting or superconductor) same (vortex or vortices)).ti.) and ((superconducting or superconductor) same (vortex or vortices)).ab.) and ((superconducting or superconductor) same (vortex or vortices)).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:02
-		10	(((superconducting or superconductor) same (vortex or vortices)).ti.) and ((superconducting or superconductor) same (vortex or vortices)).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:02

-	15	((superconducting or superconductor) same (vortex or vortices)).ti.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:05
-	18	((superconducting or superconductor) same (vortex or vortices)).clm.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:06
-	15	(((superconducting or superconductor) same (vortex or vortices)).clm.) and (flux)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:07
-	7	((((superconducting or superconductor) same (vortex or vortices)).clm.) and (flux)) and (anchor or anchoring or anchored or trap or trapping or trapped)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:07
-	4	(((((superconducting or superconductor) same (vortex or vortices)).clm.) and (flux)) and (anchor or anchoring or anchored or trap or trapping or trapped)) and (detect or detecting or detector)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/01/22 14:07